PATENT SPECIFICATION

(11) 1 462 361

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(21) Application Nos. 2983/73 (22) Filed 19 Jan. 1973
57941/73 13 Dec. 1973

(23) Complete Specification filed 18 April 1974

(44) Complete Specification published 26 Jan. 1977

(51) INT. CL.[2] A62B 17/04

(52) Index at acceptance
A3V 11D 11K
A5T 255 263 505

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(54) IMPROVEMENTS IN OR RELATING TO PROTECTIVE CLOTHING

(71) I, SECRETARY OF STATE FOR DEFENCE, London, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed to be particularly described in and by the following statement:

The present invention relates to protective headwear, and particularly to headwear worn by military personnel for protection against chemically polluted atmospheres.

According to the present invention a hood for protection of a human head against a chemically polluted atmosphere has a fabric cowl and a transparent visor, the upper and lower visor/cowl interfaces being respectively permanently and detachably sealed, the cowl and visor materials and the seals being impervious to atmospherically borne chemical pollutants, the hood having also provisions for preventing atmosphere outside the hood from reaching the head via the neck and for permitting the wearer to breathe acceptable air and/or oxygen.

Where hoods in accordance with the invention are to be used in conjunction with existing protective helmets such as those worn by aircrew, which have in the ear region hinges or pivots for a helmet visor, the hood visor may be shaped and adapted to locate on these hinges or pivot points with the helmet visor removed. Preferably the visor attaches to the hinges or pivot points by detachable detent means. The fabric in the region of the hinges and the upper edge of the visor is advantageously readily flexible.

According to a feature of the invention the lower edge of the visor may be attached to the cowl by a gas-tight sliding fastener, preferably sited and arranged to obtain support from the visor edge so that it can be readily closed and opened. Another such fastener may be fitted down the back of the cowl for the purposes of donning and removal.

The hood is intended to form part of a protective suit ensemble, and may thus be provided with means in the neck region for sealing to such a suit or with means for sealing it against the wearer's neck. Adequate sealing may be obtained in a skirt formed by excess flexible material which would overlap the wearer's shoulders and protective body garment. Both provisions may be used together. Suitable fabrics include butyl proofed nylon and neoprene nylon fabrics or neoprene or nylon dippings. The visor may be made of a plastics material such as rigid or semi-rigid methyl methacrylate, the more impact proof polycarbonate sheet or non rigid even extensible material such as polyurethane film or silicone rubber which would permit the wearer to use an optical instrument while wearing the hood.

The nature of the provision for permitting the wearer to breathe uncontaminated gas will depend upon the user situation. In a solely ground role the provision may merely comprise an adaptor allowing the passage of the gas from a supply thereof to the interior of the hood.

For use in flying and like situations, the wearer may have an oro-nasal breathing mask worn inside the hood. The hood may further be adapted for use with emergency or routine oxygen supply in a rarified atmosphere situation, such as flight at high altitude.

According to another feature of the invention, therefore, a provision for emergency oxygen supply may comprise a direct supply through the hood wall for metered constant flow oxygen to the mask. The filtered breathing air supply may remain connected to the mask, and an emergency

switching arrangement is preferably provided.

According to yet another feature of the invention, a provision for routine oxygen supply may include a regulator fitted to the cowl, the regulator being of a type which will pass oxygen on demand. The regulator may be associated with a separate supply means for breathable air, with an appropriate switch-over control, so that the supply duct from the cowl to the mask need not be duplicated. Means provided for the contingency of oxygen supply failure or regulator failure may include respectively a manual control to the breathable air supply and a manual or automatic regular bypass control adapted to provide a metered constant flow oxygen supply to the mask.

In all circumstances it may be advantageous from the points of view of personal comfort and protection for the hood interior as a whole to be maintained at a gas pressure above that of the exterior, so that the hood can be continuously purged. When an oro-nasal mask is to be employed this can be effected by allowing a separate bypass of suitable uncontaminated gas such as filtered blown air to the interior of the hood. The hood may have means for separately ducting exhalant from the mask. The hood may also have, a hood air outlet non-return valve for exhausting the hood purging gas. This may be spring loaded in order to ensure a slight positive pressure in the hood.

The hood may be provided with intercommunication means such as microphone and earphone attachments, or if used with helmet and mask which already has these, it may have an intermediate intercommunication lead passing through the hood fabric with connection means (plug or socket) inside and outside. A microphone switch may also be provided outside the hood.

A preferred embodiment of the invention, therefore, is a hood for use in conjunction with a helmet of the type worn by aircrew, the helmet having a detachable visor, built-in earphones, and an associated attached or attachable breathing mask, the hood having a fabric cowl with a skirt extension for overlapping the wearer's shoulders, a gas tight fastener enabling its fitting over the wearer's helmet, and means for sealing on the wearer's neck or protecting body garment, a visor sealed to the cowl along its upper edge and detachably attached to the cowl by a gas tight fastener along its lower edge between hinge points, means for permitting uncontaminated breathable gas to enter the interior of the hood and of the mask and means for permitting exhaled gas to leave the hood without entering the hood space, intercommunication means, the visor having detents for engaging on visor hinges or hinge studs on the wearer's helmet so that when the detents are so engaged the wearer can undo the gas tight fastener attaching the bottom edge of the visor and lift the visor and the cowl fabric, the visor material and the visor/cowl seals when closed being impervious to atmospherically borne chemical pollutants.

Such a hood may be donned by a wearer already wearing helmet and mask but with the helmet visor removed, by first plugging the breathing pipe or pipes and the intercommunication leads from the mask into the hood provisions therefore, then attaching the hood visor to the helmet hinge points, and finally fastening the gas tight hood fitting fastener. Alternatively the mask may be permanently coupled to hood mounted breathing components and attached to the helmet during the donning procedure. The visor opening facility of the hood provides a ready means of removing the mask from the face in the event of an emergency involving water entry. At the same time it is particularly useful during chemical defence flight training, because it can be opened for an emergency purpose and then readily resealed.

According to another feature of the invention provision may be made in the hood for permitting manual access to the wearer's face without opening the hood. Such access is often desired in order that the wearer may adjust his breathing apparatus or his comfort. It may comprise a pair of sealed finger stalls, for example, or a gas-tight pouch or pocket or one or more sealed gussets or convolutions in the chin region of the cowl, and perhaps in the brow region also. These pouches, pockets or convolutions may be stowable by means of fasteners such as sliding fasteners to minimise the bulk and encumbrance of their excess fabric. If the wearer feels the need to adjust the position of his mask or manipulate his face for his personal comfort he can unstow the face manipulation means and insert his fingers to carry out the said manipulation via the cowl fabric.

Particular chemicals against which the hood gives protection include those postulated for use in chemical warfare and certain at least of the chemical pollutants which may be released during industrial activity, for example asbestos dust and polyvinylchloride. The hood also affords a measure of protection against radioactive dust and bacteria.

A hood in accordance with the invention will now be described by way of example, with reference to the accompanying drawings, of which:—

Figure 1 is a side elevation of the hood whilst being worn,

Figure 2 is a diagram of one hood breathing system,

Figure 3 is a diagram of second hood breathing system, and

Figure 4 is a diagram of a third hood breathing system, for routine oxygen supply.

As shown in Figure 1 the hood comprises a cowl 11 of butyl rubber proofed nylon fabric having a skirt 12 for overlapping the wearer's shoulders. The cowl has a primary gas tight sliding fastener 13 down the back. It is fitted with a Perspex (Trade Mark) visor 14 which is sealed to the cowl along its upper edge but detachable therefrom along its lower edge by means of a gas tight slide fastener 15 which runs approximately from visor hinge point to hinge point. A suitable slide fastener has the teeth at each side protruding through the corresponding sheet of fabric to be joined, near the edge of the fabric, so that when the fastener is closed and the teeth engage into each other the surfaces of the fabric sheets are pressed together. The visor is thus linked to one side of the fastener 14 by a lip 16 of the fabric.

The hood is made to fit over a helmet 17 and the visor has at each side a manually operable detent 18 by which it can be mounted on helmet hinges or hinge studs. The position of these hinges and the shape of the visor are such that the visor can be raised above the head, clearing the helmet sufficiently not to overstress the fabric and so the visor profile presents no unacceptable limitation to the field of view when down or up.

In the chin region of the hood, below the fastener 15, there is formed a series of radial convolutions 19 normally closed and restrained by a slide fastener 20. The convolutions provide sufficient excess fabric such that when they are unrestrained the visor can be raised without opening the hood, and the 'loose' fabric raised to allow the wearer to reach with his fingers to at least the vicinity of the nose.

The helmet 17 has an associated breathing mask 21 which is fastened over the oro-nasal area of the face of the wearer. The cowl is fitted with a valve chest 22 for passing filtered breathing gas to the interior of the hood and of the mask. It is also fitted with an adaptor 23 (see Figure 2) for the exhaust of exhaled air from the mask and an adaptor 24 for connecting microphone and earphone leads. A spring loaded exhaust non-return valve 25 is fitted to the neck region of the cowl.

The layout of the breathing system indicated in Figure 1 is shown more clearly in Figure 2. The valve chest 22 which can be connected to a filtered breathing gas is a forked duct which has on one side a spring loaded non-return valve 30 for allowing gas into the interior of the hood generally, and maintaining a mask positive safety pressure relative to hood space and on the other a connection for a flexible tube 31 to the mask 21, the mask having a non-return valve 21*a* permitting inboard flow. The other breathing component contains a non-return valve 32 for allowing exhaled mask gas to leave the hood, for which purpose the adaptor 23 connects with a flexible tube 33 from the mask 21. The non-return valve 32 is backed up by a second mask-mounted non-return valve (not shown) to ensure the non-entry of toxic agents.

The hood described may be donned together with the helmet 17 as an assembly, the visor 14 having already been attached at the hinges 18, the fasteners 12 and 15 being fully open and the visor 14 raised. Once the helmet/hood is on the wearer's head the fastener 12 is fully closed bringing the neck skirt to bear on the wearer's neck or body garment neckline. The mask 21 is then fastened into place with the tubes 31 and 33 connected to the adaptors 22 and 23 respectively. The microphone and earphone leads are connected to the adaptor 24. The visor may then be lowered and the fastener 15 closed.

The wearer's head will then be protected against a chemically polluted atmosphere and he will be able to breathe and communicate with the outside world. In breathing, the facial atmosphere between the mask and the hood may tend to follow a similar pattern of pressure fluctuation, and gas in excess of that inhaled will be allowed into the hood by the spring-loaded non-return valve 30. Due to the exhaust valve 25 being spring-loaded, however, a pressure slightly higher than that outside the hood may be maintained inside. This serves to prevent the ingress of contaminated atmosphere from outside the hood.

The wearer is at risk if his aircraft is ditched in water, of suffocating or sucking water into the mask. For such an emergency, the facility of opening the fastener 15 and raising the visor 14 is provided. The breathing mask 21 may then be removed. The facility is also useful during chemical defence training flights.

In the second breathing system shown in Figure 3 the mask 40 has only one breathing tube 41. The hood is fitted with an adaptor 42 which would replace the adaptors 22 and 23 of Figures 1 and 2. The adaptor 42 has an inlet connector 43, a non-return valve 44 to the interior of the

hood, and a breathing tube 41 to a connector 45 as before.

It has also a non-return valve 46 between the supply to the valve and the connector 43 for preventing exhaled gas from going back down the supply or into the hood interior. A spring loaded non-return valve 47, a non-return valve 48 in series and an orifice 49 in the adaptor 42 permit the exhaust of inhaled air from the tube 41.

Figure 4 illustrates a preferred breathing system when the hood has to be used in a routine oxygen supply situation.

It shows an adaptor 50 located in a cowl 11, and an oxygen regulator 51 attached to the adaptor 50 inside the cowl 11. The regulator 51 has an outlet communicating with an inner chamber 52 in the adaptor and an inlet communicating with an oxygen supply tube 53, to which an emergency oxygen supply also feeds. The chamber 52 communicates also via a tube 54 with the mask 21, and via an anti-suffocation valve 55 with an outer chamber 56. The valve 55 is a non-return valve preventing gas flow from the inner chamber 52 to the outer chamber 56. The valve 55 has, however, a manual override 57 with detents (not shown) for the fully in and out position. The outer chamber 56 has an inlet tube 58 for connection to a supply of filtered air and a non-return valve 59 allowing gas flow only from the chamber 56 to the interior of the cowl 11.

The oxygen supply tube 53 has a regulator emergency by-pass 60 which communicates via a hole 61 in the override 57 with the inner chamber 52. The override 57 is thus dual purpose, operating in push/pull mode for switching between oxygen and filtered air supplies and in rotary mode for opening/closing the regulator by-pass 60.

The mask 21 is exhausted via a compensated expiratory valve in the mask and (32 in Figure 2) via a tube 33 and a non-return valve (not shown) in the cowl 11.

In the configuration shown in the drawing the hood is adapted to supply demand oxygen to the mask 21 and filtered blown air via the tube 58, the chamber 56 and the valve 59 to the interior of the hood only. Upon each inhalation by the wearer, the regulator senses the pressure drop in the chamber 52 and permits oxygen to pass therethrough from the supply 53. Exhalate passes out via the tube 33.

If in this configuration oxygen fails to be drawn up the tube 54 then upon inhalation the anti-suffocation valve 55 will open. This however is arranged to require a greater suction to operate than does the regulator and its operation will be sensed by the wearer. If the wearer thinks that the loss of oxygen supply may be due to failure of the regulator 51 he can turn the override 57 and thus open the oxygen by-pass 60. This will, if the fault is in the regulator 51, supply metered oxygen at a constant rate to the chamber 52. If the failure is in the oxygen supply upstream of the regulator 51 the wearer will sense this because of continuing inspiratory resistance of the anti-suffocation valve 55. At this stage the limited emergency oxygen supply would be utilised for immediate descent to a safe altitude at which filtered air breathing is physiologically acceptable. Air breathing, after discharge of the emergency oxygen supply would be achieved by pushing the override 57. This closes off the by-pass 60 if open and lifts the valve 55, which by virtue of a detent will remain open, and the chamber 52 will be open to a supply of filtered air via the tube 58.

The above embodiment is particularly suitable for use by aircrew in high performance aircraft where oxygen and filtered air supplies may readily be installed. Insofar as the filtered air supply operates on environmental air without maintaining a store of same then clearly in the event of a failure of oxygen supply at high altitude, other than failure of the regulator 51, the aircraft will have to be brought to an acceptable altitude for filtered air breathing.

If it is required that aircrew should be protected whilst proceeding to or from their aircraft portable filter blower units may be provided and these can, if separate aircraft installed units are not provided, be arranged for mounting and operation within the aircraft once the aircrew are inside.

It will be appreciated that the invention does not include the oxygen mask, the breathing systems and the oxygen regulator per se or their use in contexts other than the hoods herein described and claimed. Indeed the embodiment of Figure 2 may employ a standard P or Q type oxygen mask currently in military service, while the embodiment of Figure 3 may employ a similar mask but with the mask mounted valves removed and one aperture blanked off. For the embodiment of Figure 4 there is a number of 100% oxygen miniature regulators which are available for the use described.

WHAT I CLAIM IS:

1. A hood for protection of a human head and respiratory system against a chemically polluted atmosphere having a fabric cowl and a transparent visor with upper and lower visor/cowl interfaces which are respectively permanently and detachably sealed, the cowl and visor materials and the seals being impervious to atmospherically borne chemical pollutants,

the hood having also provisions for preventing atmosphere outside the hood from reaching the head via the neck and for permitting the wearer to breathe acceptable air and/or oxygen.

2. A hood as claimed in claim 1 and having detachable detent means for attachment to visor pivot points of a protective helmet.

3. A hood as claimed in claim 1 or claim 2 and wherein the lower edge of the visor is attached to the cowl by a gas-tight sliding fastener.

4. A hood as claimed in any one of claims 1 to 3 and having a gas-tight sliding fastener down the back thereof for donning and doffing purposes.

5. A hood as claimed in any one of claims 1 to 4 and having a flexible skirt for overlapping the wearer's shoulders and formed by excess material.

6. A hood as claimed in any one of the preceding claims and wherein the visor is made of rigid or semi-rigid plastics material.

7. A hood as claimed in any one of claims 1 to 5 and wherein the visor is made of film or non-rigid plastics material.

8. A hood as claimed in any one of the preceding claims and adapted for use when the wearer also has a breathing mask.

9. A hood as claimed in claim 8 and having provision for routine oxygen supply, including a regulator fitted to the hood wall, the regulator being adapted for connection to an oxygen supply and being of a type which will pass oxygen on demand.

10. A hood as claimed in claim 9 and wherein the regulator is associated with a separate supply of breathable air by means which include an appropriate switch-over control, and a supply duct passing through the cowl, the duct being common to both supplies

11. A hood as claimed in claim 10 and having failure compensation means including a manual control to the breathable air supply and a manual or automatic regulator bypass control adapted to provide a metered constant flow oxygen supply to the mask.

12. A hood as claimed in any one of the claims 8 to 11 and having a separate duct for ducting exhalant from the mask to the exterior of the hood.

13. A hood as claimed in any one of the preceding claims and having a hood air outlet non-return valve for exhausting hood purging gas.

14. A hood as claimed in claim 13 and wherein the non-return valve is spring-loaded.

15. A hood as claimed in any one of the preceding claims and provided with intercommunication means.

16. A hood for use in conjunction with a helmet of the type worn by aircrew, the helmet having a detachable visor, built-in earphones, and an associated attachable breathing mask, the hood having a fabric cowl with a skirt extension for overlapping the wearer's shoulders, a gas tight fastener enabling its fitting over the wearer's helmet, and means for sealing on the wearer's neck or protecting body garment, a visor sealed to the cowl along its upper edge and detachably attached to the cowl by a gas tight fastener along its lower edge between hinge points, means for permitting uncontaminated breathable gas to enter the interior of the hood and of the mask and means for permitting exhaled gas to leave the hood without entering the hood space, inter-communication means, the visor having detents for engaging on the visor hinges or hinge points of the wearer's helmet so that when the detents are so engaged the wearer can undo the gas tight fastener attaching the bottom edge of the visor and lift the visor and the cowl fabric, the visor material and the visor/cowl seals when closed being impervious to atmospherically borne chemical pollutants.

17. A hood as claimed in any one of the preceding claims and having provision for permitting manual access to the wearer's face without opening the hood.

18. A hood as claimed in claim 17 and wherein the said provision comprises convolutions stowable by means of a sliding fastener.

19. A hood substantially as hereinbefore described.

20. Any hood substantially as hereinbefore described with reference to the accompanying drawings.

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Agent for the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1977.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1 462 361 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

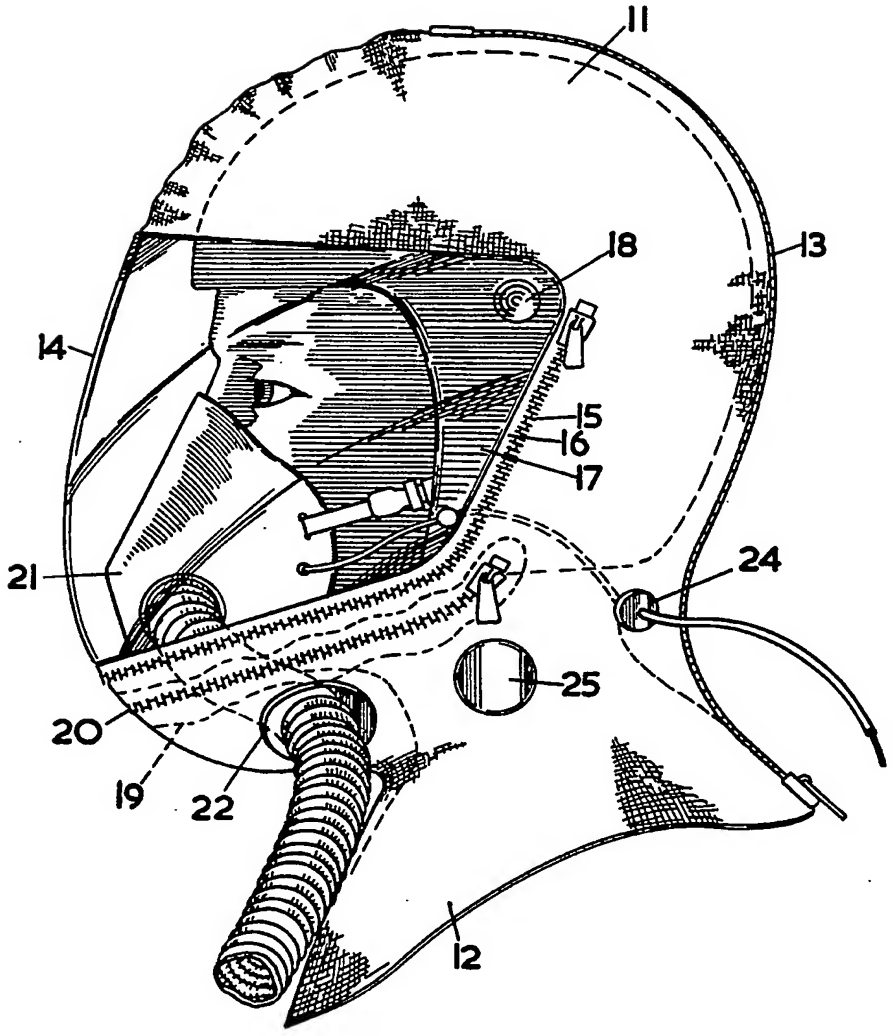

FIG. 1.

1 462 361 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

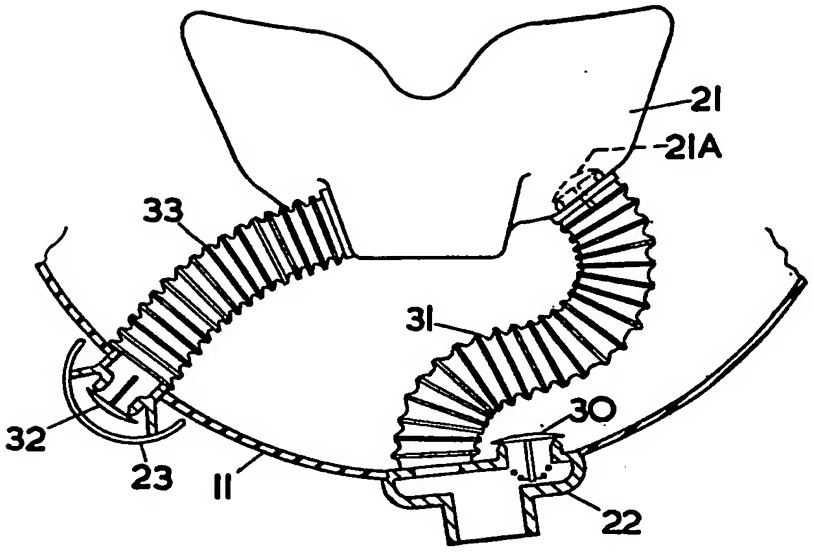

FIG. 2.

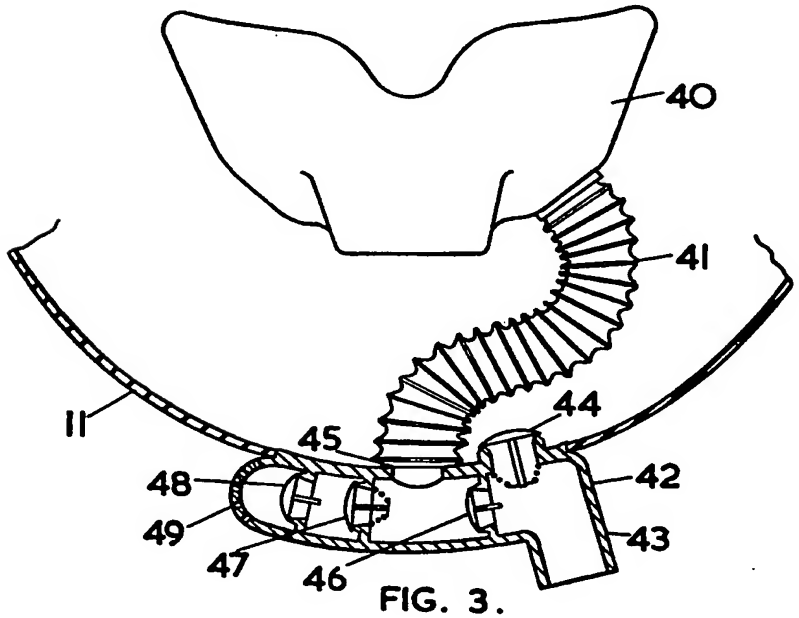

FIG. 3.

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COMPLETE SPECIFICATION

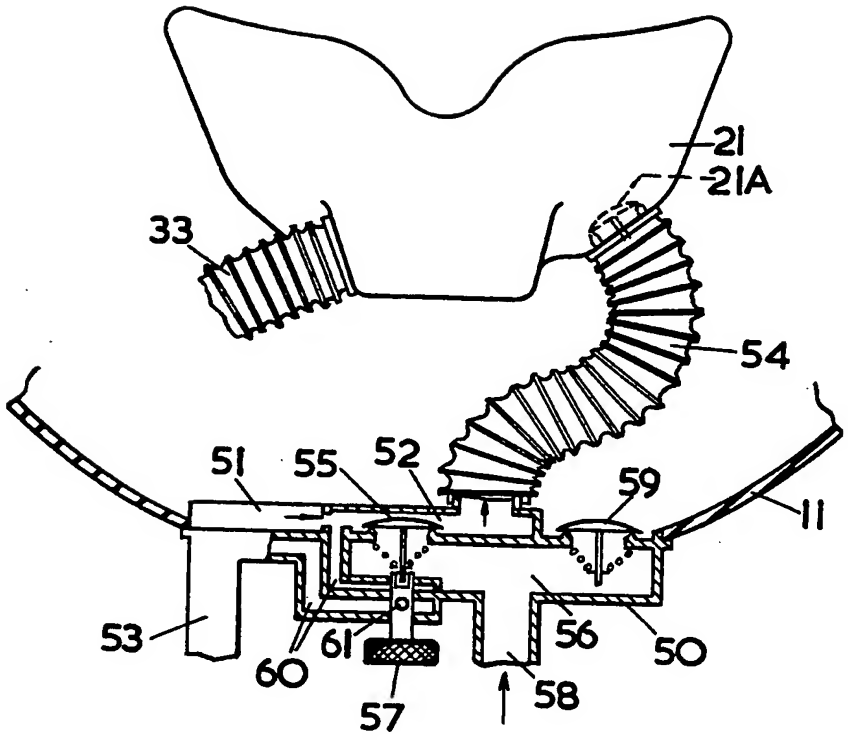

FIG. 4.